Names: Kyle Thompson, Konnor Kivimagi

Section: 4

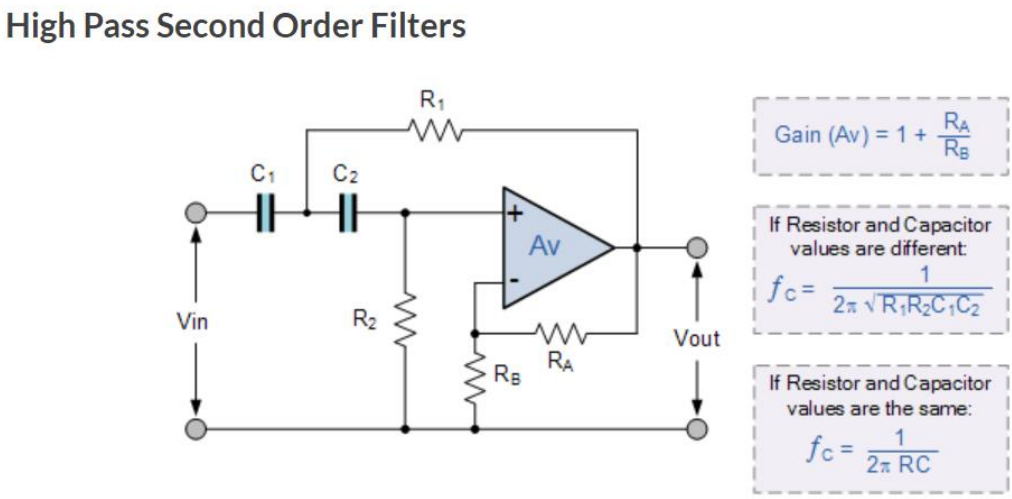
Lab Time: Wednesday 11am – 1:50pm

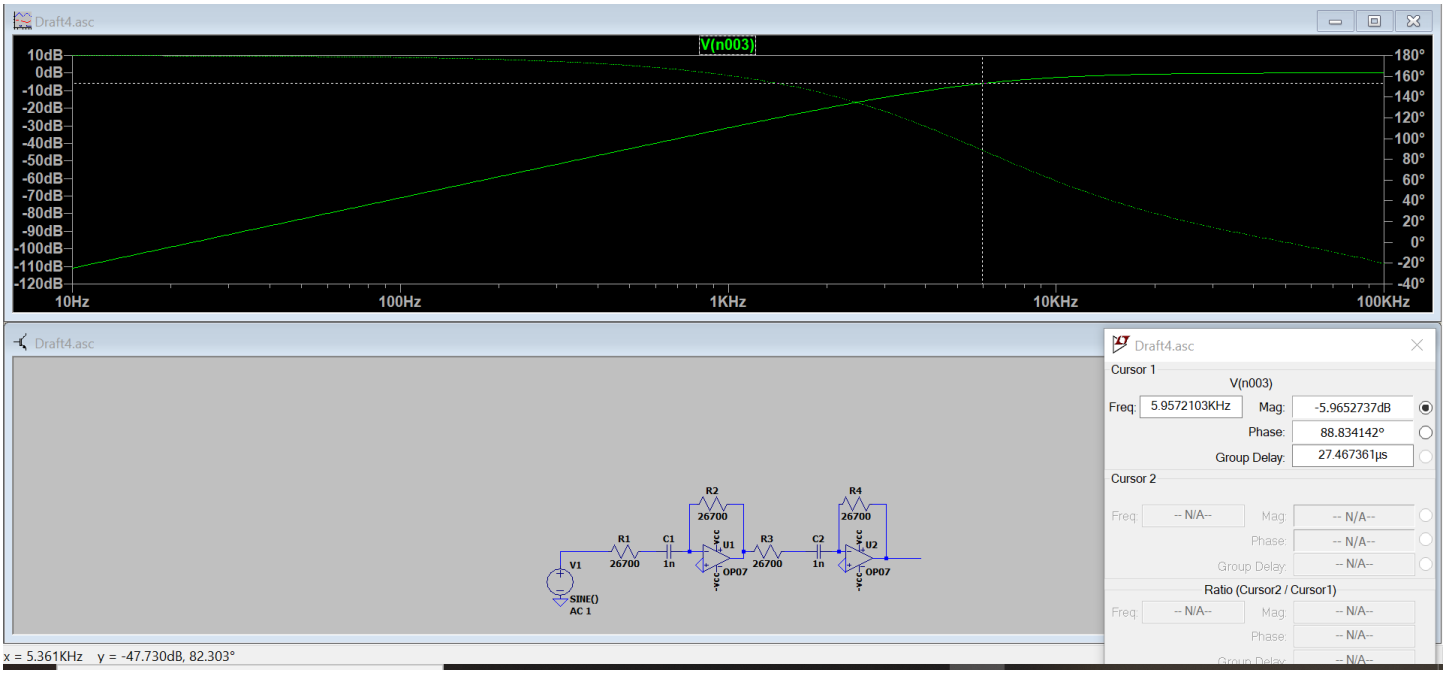
TAs: Raufer Khan and Yang Tian

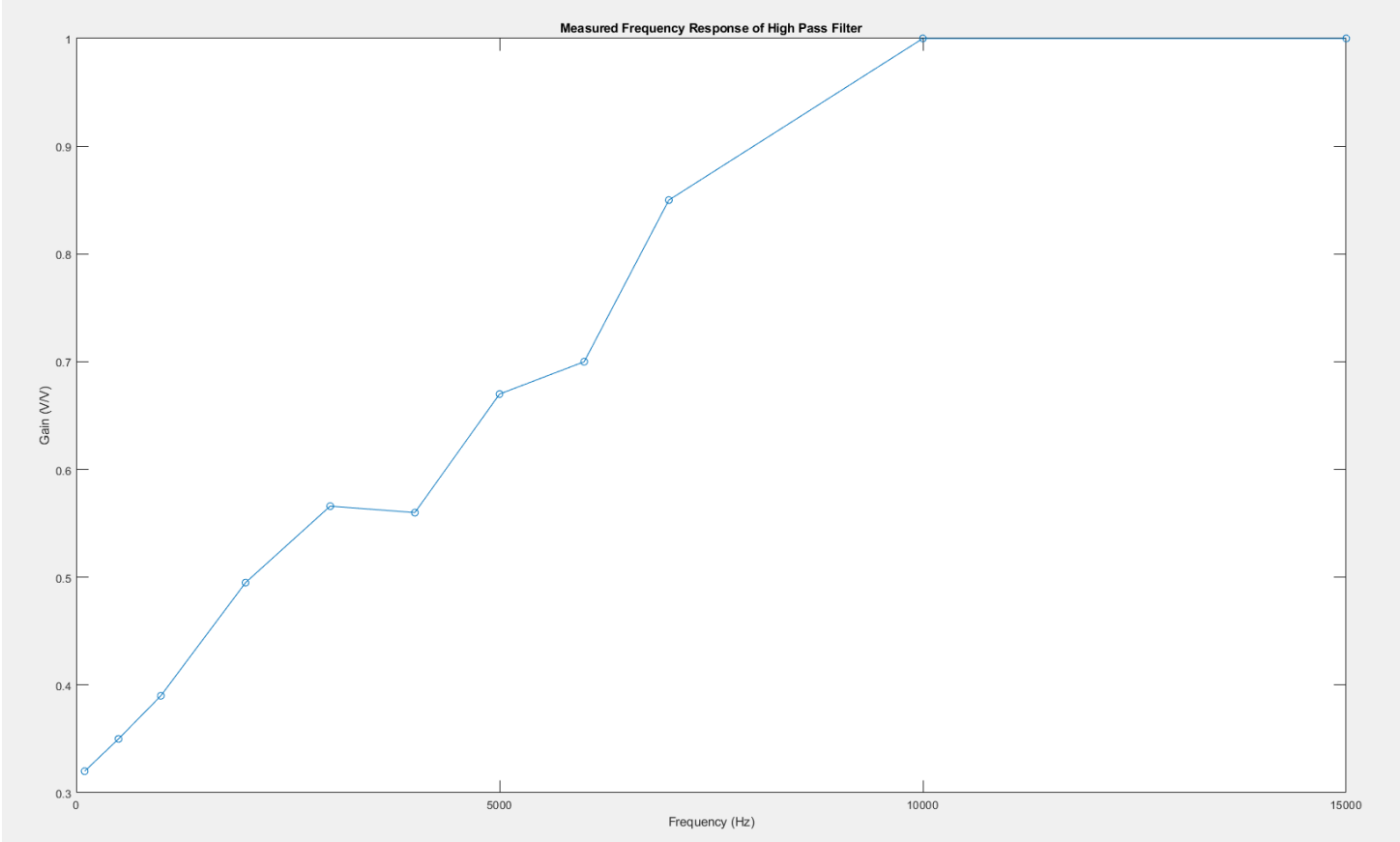
Lab 7: Design Lab - Active crossover network

Tweeter

The high pass filter or tweeter was designed using the third equation in the figure below. This was used to find a first-order high pass circuit with a cutoff frequency of 6000Hz and a capacitor value of 1 nano-farad to create an input resistance of greater than 10000Ω. Then two of these first-order high pass filters were cascaded together to make a second-order high pass with a cutoff frequency of 6000Hz as shown in the LtSpice figure below.

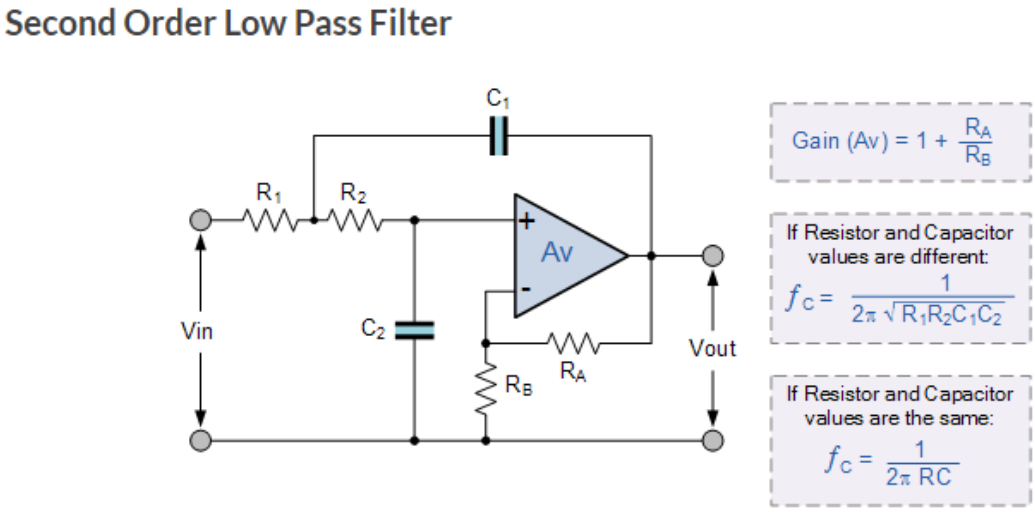


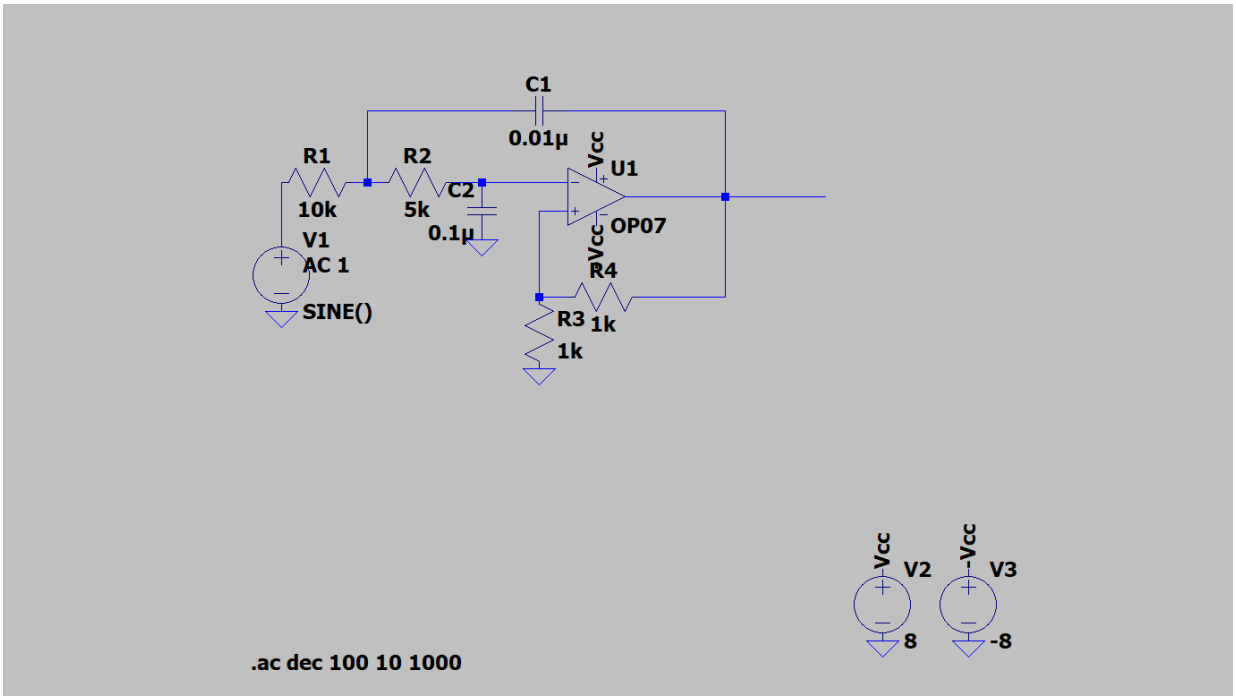

Draft4.asc
V(n003)
10dB
0dB
-10dB
-20dB
-30dB
-40dB
-50dB
-60dB
-70dB
-80dB
-90dB
-100dB
-110dB
-120dB
180°
160°
140°
120°
100°
80°
60°
40°
20°
0°
-20°
-40°
10Hz
100Hz
1KHz
10KHz
100KHz
Draft4.asc
R2
26700
R4
26700
R1
26700
C1
1n
U1
OP07
R3
26700
C2
1n
U2
OP07
V1
SINE()
AC 1
Draft4.asc
Cursor 1
V(n003)
Freq: 5.9572103KHz
Mag: -5.9652737dB
Phase: 88.834142°
Group Delay: 27.467361µs
Cursor 2
Freq: -- N/A--
Mag: -- N/A--
Phase: -- N/A--
Group Delay: -- N/A--
Ratio (Cursor2 / Cursor1)
Freq: -- N/A--
Mag: -- N/A--
Phase: -- N/A--
x = 5.361KHz y = -47.730dB, 82.303°

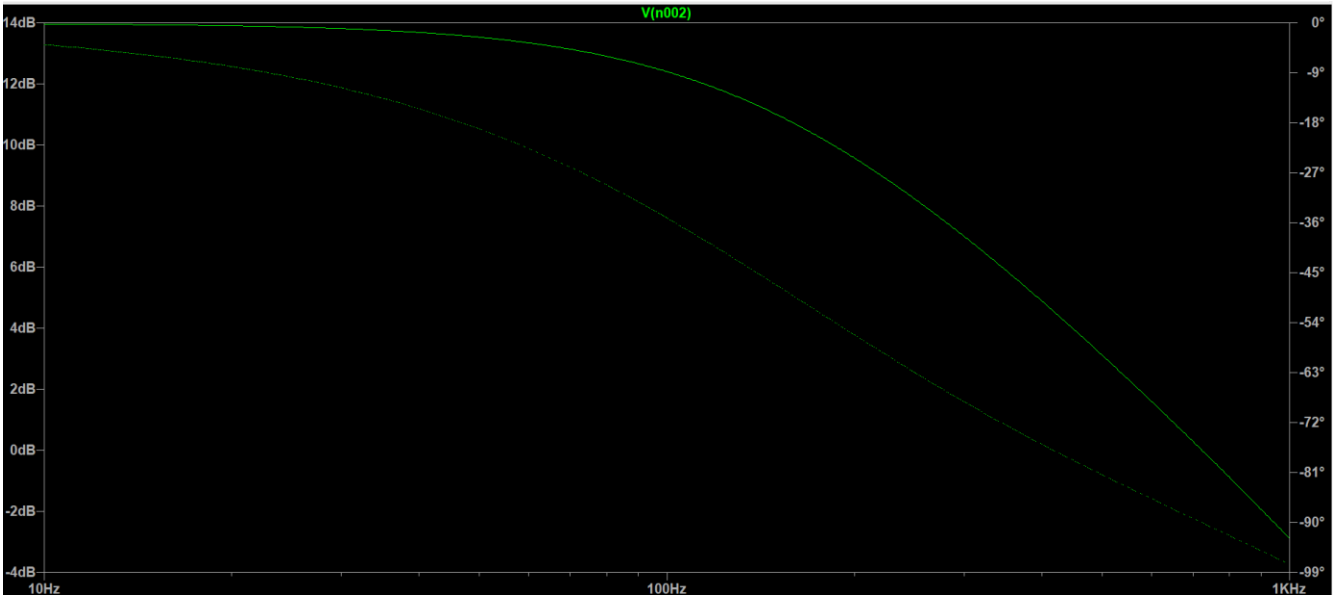

Measured Frequency Response of High Pass Filter
Gain (V/V)
Frequency (Hz)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0
5000
10000
15000

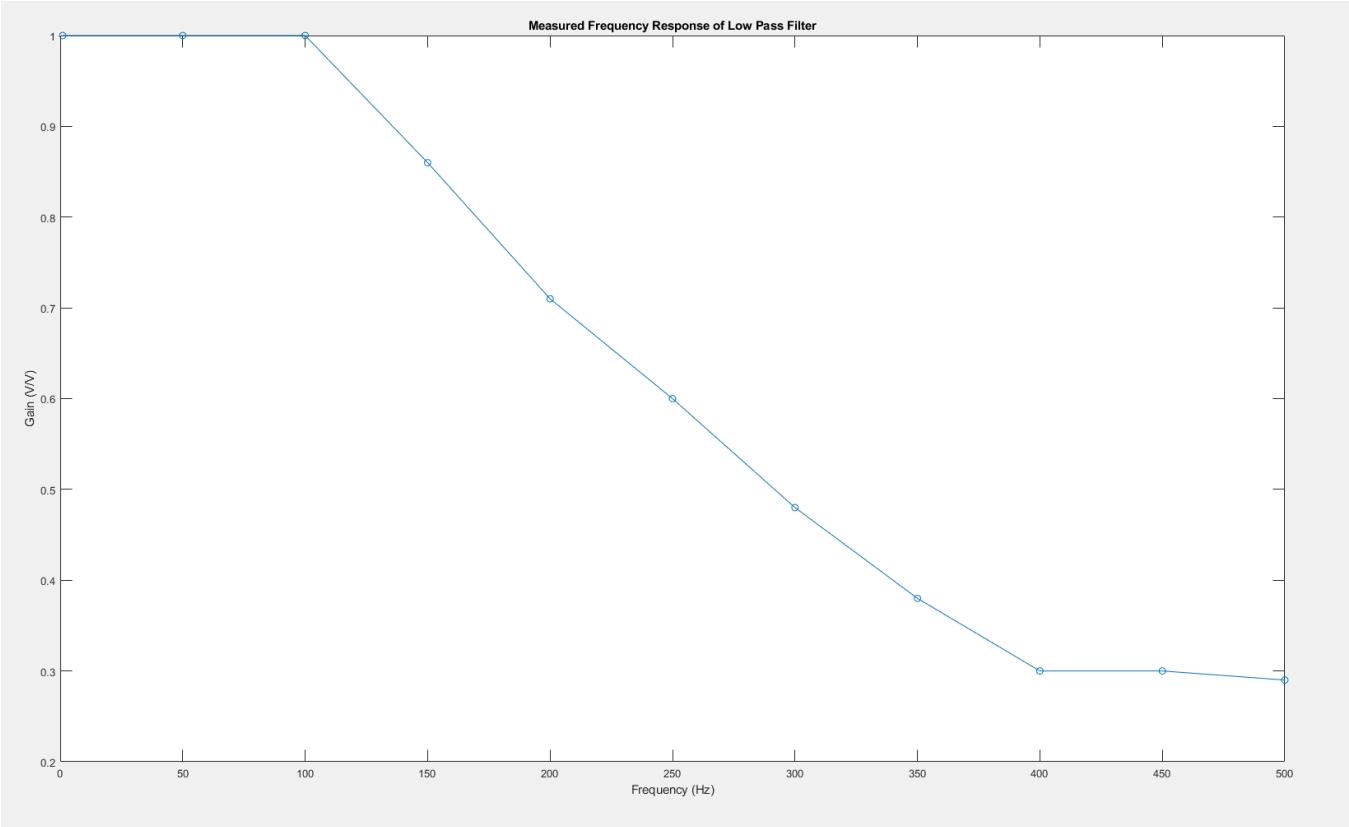
Woofer

The low-pass filter or woofer was designed using the image and equations shown below. It was designed with an input resistance of 10000Ω and the ability to change its gain between 1 and 5. The gain was changed by replacing resistor Ra with a potentiometer.



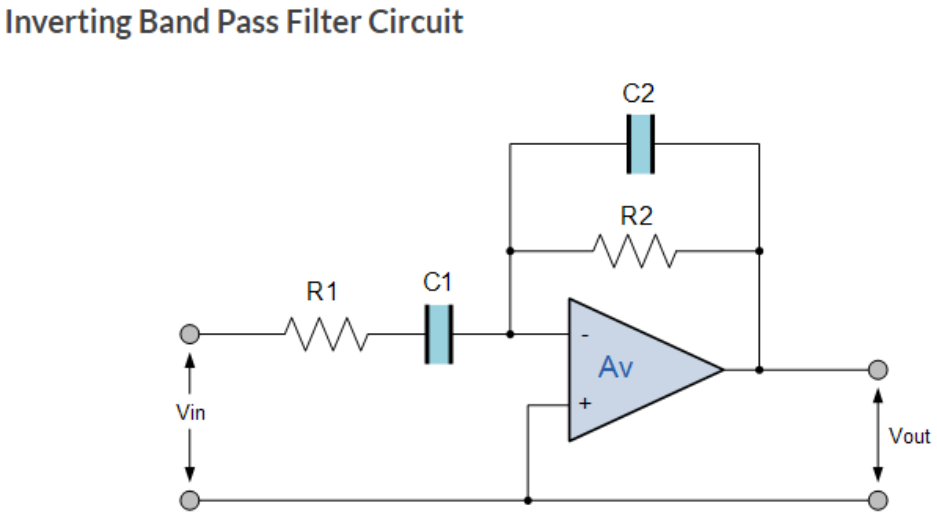



V(n002)
14dB
12dB
10dB
8dB
6dB
4dB
2dB
0dB
-2dB
-4dB
0°
-9°
-18°
-27°
-36°
-45°
-54°
-63°
-72°
-81°
-90°
-99°
10Hz
100Hz
1KHz

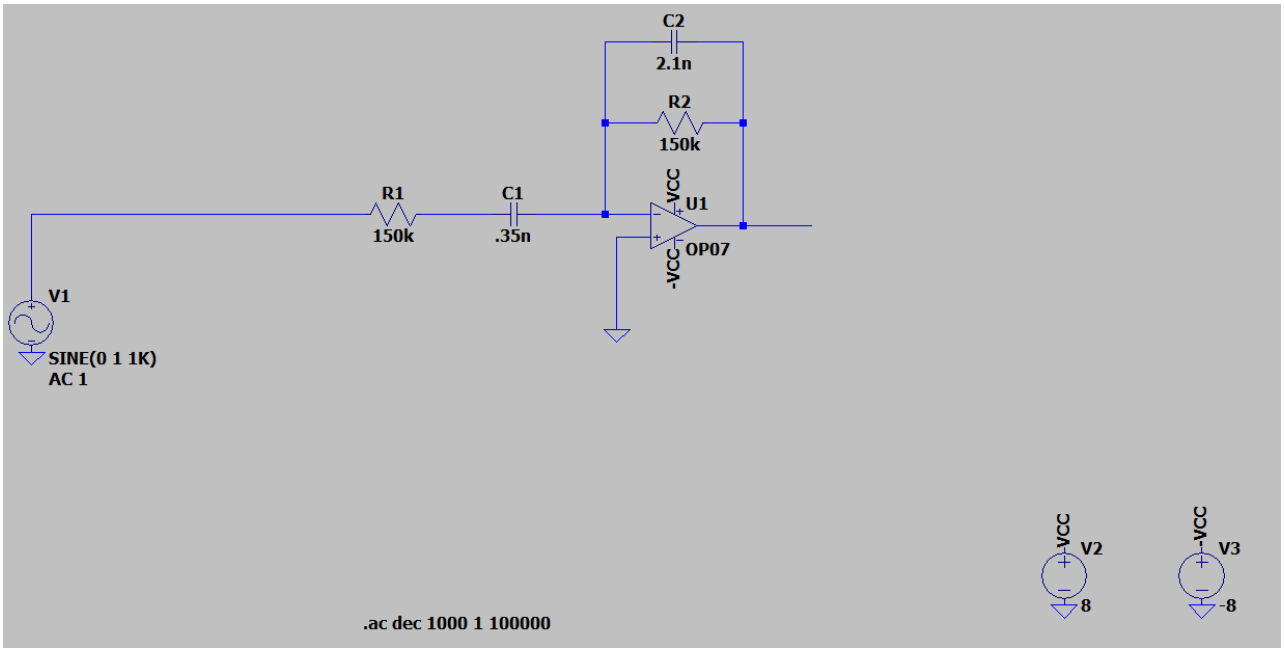

Measured Frequency Response of Low Pass Filter
Gain (V/V)
Frequency (Hz)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
50
100
150
200
250
300
350
400
450
500

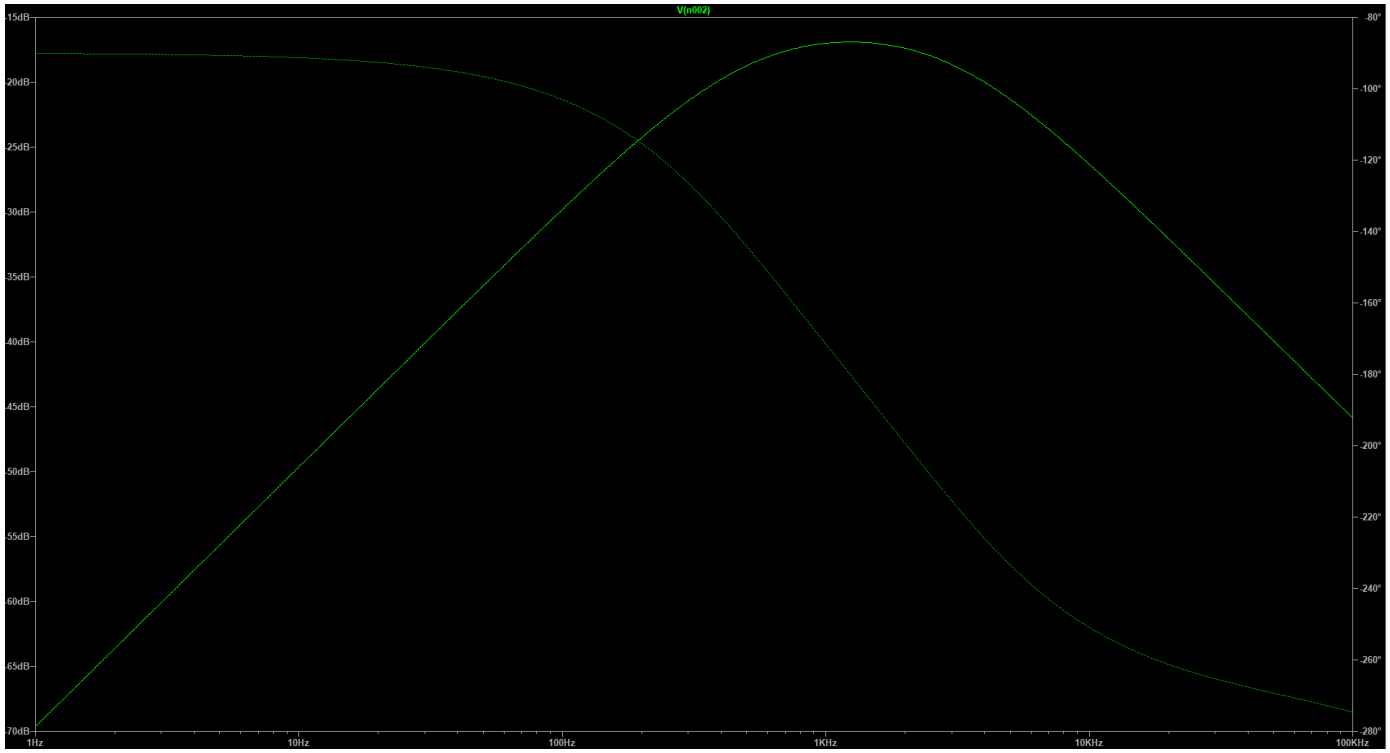
Squawker

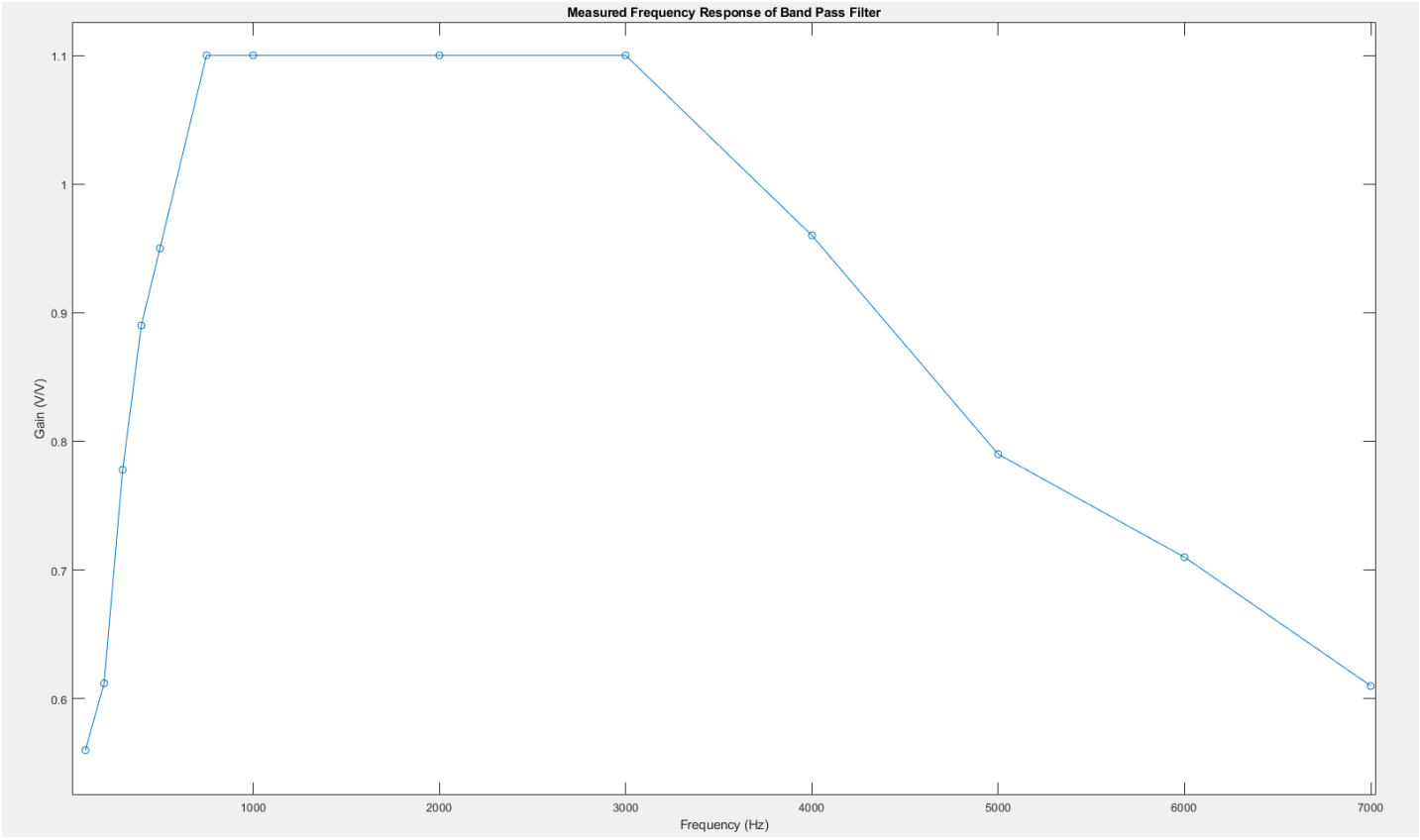
The band pass filter or squawker was designed using the equations and layout pictured in the picture below. The resistor values were chosen to be 150kΩ and had to be equal to obtain a gain of 1. The capacitor values were calculated based on these resistor values.



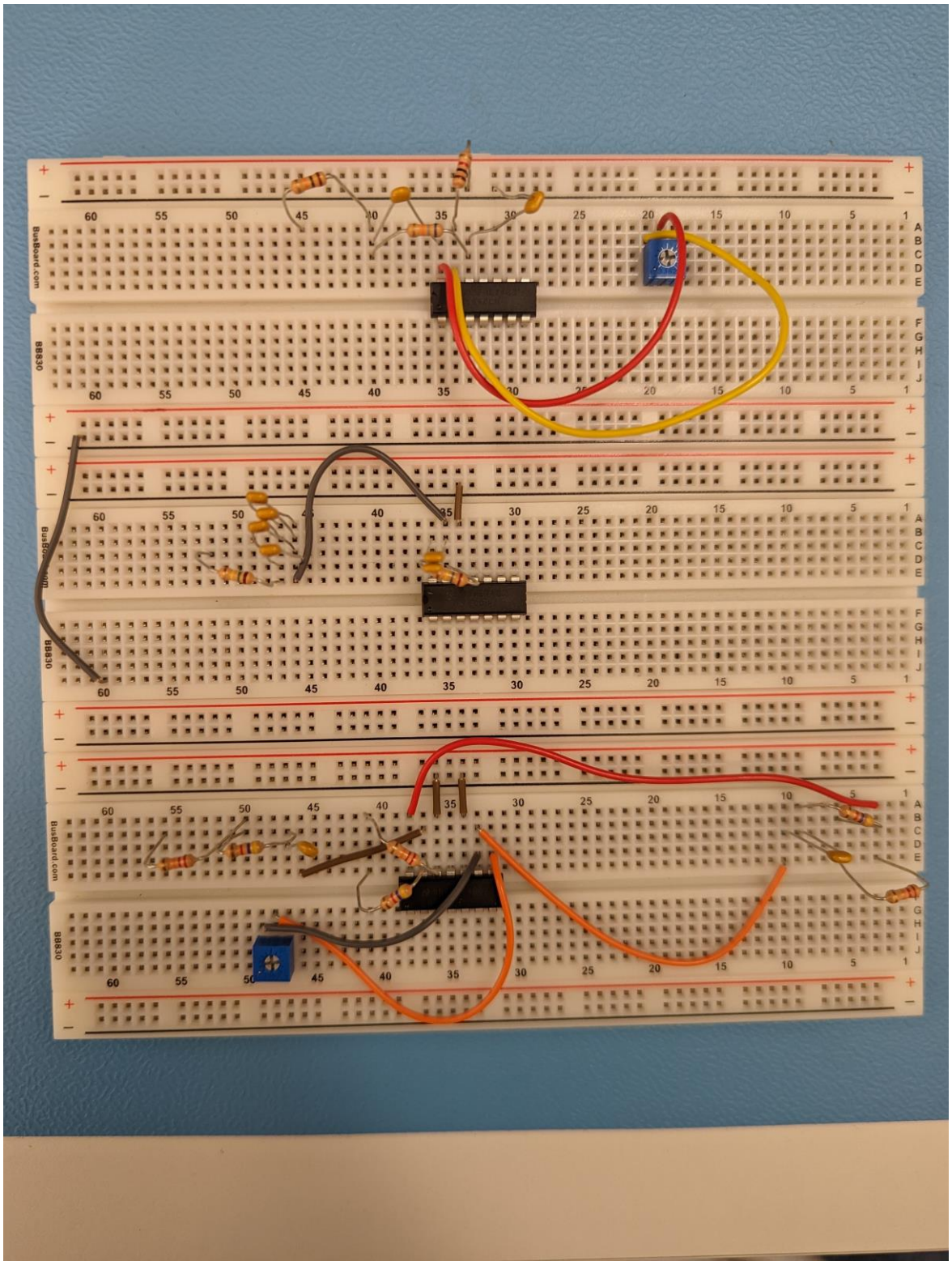
$$Voltage\ Gain = -\frac{R_2}{R_1},\quad fc_1 = \frac{1}{2\pi R_1 C_1},\quad fc_2 = \frac{1}{2\pi R_2 C_2}$$




V(n002)
15dB
20dB
25dB
30dB
35dB
40dB
45dB
50dB
55dB
60dB
65dB
70dB
-80°
-100°
-120°
-140°
-160°
-180°
-200°
-220°
-240°
-260°
-280°
1Hz
10Hz
100Hz
1KHz
10KHz
100KHz


Measured Frequency Response of Band Pass Filter
Gain (V/V)
1.1
1
0.9
0.8
0.7
0.6
1000
2000
3000
4000
5000
6000
7000
Frequency (Hz)

Below is our design implemented on a breadboard.



Below is the full circuit diagram for our design.